

SYSTEM TIMINGS

Key to abbreviations used in formulas

L_A	=	Length of the A-field
L_B	=	Length of the B-field
L_O	=	Length of Multiplier field
L_I	=	Length of Instruction
L_M	=	Length of Multiplier field
L_Q	=	Length of Quotient field
L_R	=	Length of Divisor field
L_S	=	Number of significant digits in Divisor (Excludes high-order 0's and blanks)
L_W	=	Length of A- or B-field, whichever is shorter
L_X	=	Number of characters to be cleared
L_Y	=	Number of characters back to right-most "0" in control field
L_Z	=	Number of 0's inserted in a field
I/O	=	Timing for Input or Output cycle
F_m	=	Forms movement times. Allow 20 ms for first space, plus 5 ms for each additional space
T_m	=	Tape movement times
Σ	=	Number of fields included in an operation

SYSTEM TIMINGS

OPERATION	OP CODE	FORMULA
Punch a Card	4	$.0115 (L_I + 1) + I/O$
Read a Card	1	$.0115 (L_I + 1) + I/O$
Read and Punch	5	$.0115 (L_I + 1) + I/O$
Select Stacker	K	$.0115 (L_I + 1)$
Set Word Mark	9	$.0115 (L_I + 3)$
Start Punch Feed*	9	$.0115 (L_I + 1)$
Start Read Feed*	8	$.0115 (L_I + 1)$
Store A-address Register*	Q	$.0115 (L_I + 5)$
Store B-address Register*	H	$.0115 (L_I + 4)$
Subtract (no recomplement)	S	$.0115 (L_I + 3 + L_A + L_B)$
Subtract (recomplement)	S	$.0115 (L_I + 3 + L_A + 4 L_B)$
Write a Line	2	$.0115 (L_I + 1) + I/O$
Write and Punch	6	$.0115 (L_I + 1) + I/O$
Write and Read	3	$.0115 (L_I + 1) + I/O$
Write, Read and Punch	7	$.0115 (L_I + 1) + I/O$
Zero and Add	?	$.0115 (L_I + 1 + L_A + L_B)$
Zero and Subtract	1	$.0115 (L_I + 1 + L_A + L_B)$

TAPE OPERATIONS

T_m — Tape movement can be determined from the following:

1 = Number of Characters
C = Character Rate

729 II at 200 cpi = .067 ms	729 V at 200 cpi = .067 ms
at 556 cpi = .024 ms	at 556 cpi = .024 ms
	at 800 cpi = .017 ms

729 IV at 200 cpi = .044 ms	7330 at 200 cpi = .139 ms
at 556 cpi = .016 ms	at 556 cpi = .050 ms

729 Model II and V Read	$10.7 + CN \text{ ms} = \text{TAU interlocked}$
	$10.5 + CN \text{ ms} = \text{Processing interlocked}$
Write	$11.7 + CN \text{ ms} = \text{TAU interlocked}$
	$7.5 + CN \text{ ms} = \text{Processing interlocked}$

729 Model IV, Read	$6.8 + CN \text{ ms} = \text{TAU interlocked}$
	$6.7 + CN \text{ ms} = \text{Processing interlocked}$
Write	$7.8 + CN \text{ ms} = \text{TAU interlocked}$
	$5 + CN \text{ ms} = \text{Processing interlocked}$

7330 Read	$20.5 + CN \text{ ms} = \text{TAU interlocked}$
	$7.7 + CN \text{ ms} = \text{Processing interlocked}$
Write	$20.3 + CN \text{ ms} = \text{TAU interlocked}$
	$5 + CN \text{ ms} = \text{Processing interlocked}$

Rewind

729 Models II and V	= 1.2 minutes/reel
729 Model IV	= .9 minutes/reel
7330 (High Speed)	= 2.2 minutes/reel

Skip and Blank Tape

(add to subsequent write time)

729 Models II and V	= 40.5 ms
729 Model IV	= 27 ms
7330	= 103 ms

Backspace (after Read)

729 Models II and V	= $46 + CN \text{ ms}$
729 Model IV	= $33 + CN \text{ ms}$
7330	= $428 + CN \text{ ms}$

Backspace (after Write)

729 Models II and V	= $52 + CN \text{ ms}$
729 Model IV	= $37 + CN \text{ ms}$
7330	= $435 + CN \text{ ms}$

IBM 1401 Data Processing System Reference Card

INSTRUCTION FORMAT

The IBM 1401 Data Processing System uses a variable word-length concept; the length of an instruction can vary from one to eight characters.

OP CODE	A- or I-ADDRESS	B-ADDRESS	d-CHARACTER
X	XXX	XXX	X

Op Code: This is always a single character which defines the basic operation being performed. A word mark is always associated with the operation code position of an instruction.

A-Address: This always consists of three characters. It can identify the units position of the A-field, or it can be used to select a special unit or feature (tape unit, column binary feature, disk storage, inquiry, etc.).

I-Address: Instructions that can cause program branches use the I-address to specify the location of the next instruction to be executed if a branch occurs.

B-Address: This is a three-character storage address associated with the B-field. It usually addresses the units position of the B-field, but in some operations, such as tape or disk record read and write, it specifies the high-order position of a record storage area.

d-Character: The d-character is used to modify an operation code. It is a single alphabetic, numerical, or special character, positioned as the last character of an instruction. It can be used with instructions of any length.

PROCESSING OVERLAP

A-Address

The hundreds position of the A-address of a tape or input-output unit (not 1405 or 1407) instruction is changed from % to @. The symbol is used to signal an overlap operation with character reader, magnetic tape, paper tape, and data transmission units.

Overlap Mode

The following instructions are used when the system is in the overlap mode and card, printer or serial I/O operations are to be performed.

INSTRUCTION	FUNCTION
K\$	Overlap On
K(I)\$	Overlap On And Branch
K●	Overlap Off
K(I)●	Overlap Off And Branch
K□	Reset Overlap
K(I)□	Reset Overlap and Branch

1405 TIMING

TIMINGS (Model 2)	MAX.	AVG.	MIN.
Disk to Disk	800 ms	600 ms	450 ms
Track to Track	250 ms	175 ms	100 ms
Record to Record, same Track	50 ms	25 ms	

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* Special Feature

Form X24-6447-6

Printed in U. S. A.

OPERATION CODE	FUNCTION	MNEMONIC	BCD CODE	CARD CODE
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INPUT-OUTPUT CODES

1	Read a Card	R	1	1
2	Write a Line	W	2	2
2 □	Write Word Marks		□ is modifier	
3	Write-Read	WR	C21	3
4	Punch a Card	P	4	4
4R	Read-Punch Feed*		R is modifier	
4(I)R	Read-Punch Feed and Branch*		R is modifier	
5	Read-Punch	RP	C41	5
6	Write-Punch	WP	C42	6
6R	Write-Read Punch Feed*		R is modifier	
6(I)R	Write-Read Punch Feed and Branch*		R is modifier	
7	Write-Read-Punch	WRP	421	7
8	Start Read Feed*	SRF	8	8
9	Start Punch Feed*	SPF	C81	9

ARITHMETIC CODES

A	Add	A	BA1	12-1
S	Subtract	S	CA2	0-2
?	Zero and Add	ZA	CBA82	12-0
!	Zero and Subtract	ZS	B82	11-0
@	Multiply*	M	C84	4-8
%	Divide*	D	A84	0-4-8

LOGIC OPERATION CODES

B(I)	Branch	B	BA2	12-2
B(I)d	Branch if Indicator ON		d is modifier	
B(I)(B)d	Branch if Character is Equal	Contents of B compared to d		
V(I)(B)d	Branch if: WM and/or Zone	BWZ	A41	0-5

MOVE AND LOAD CODES

D	Move Numerical	MN	BA4	12-4
L	Load Character to A Word Mark	LCA	B21	11-3
M	Move Characters to A or B Word Mark	MCW	CB4	11-4
Y	Move Zone	MZ	CA8	0-8
Z	Move Characters and Suppress Zeros	MCS	A81	0-9
'	Set Word Mark	SW	CA821	0-3-8
□	Clear Word Mark	CW	CBA84	12-4-8

* Special Feature

OPERATION CODE	FUNCTION	MNEMONIC	BCD CODE	CARD CODE
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MISCELLANEOUS OPERATION CODES

C	Compare	C	CBA21	12-3
E	Move Characters and Edit	MCE	CBA41	12-5
F	Control Carriage	CC	CBA42	12-6
H	Store B-Address Register*	SBR	BA8	12-8
K	Select Stacker	SS	CB2	11-2
N	No Operation	NOP	B41	11-5
Q	Store A-Address Register*	SAR	CB8	11-8
/	Clear Storage	CS	CA1	0-1
.	Halt	H	BA821	12-3-8
#	Modify Address*	MA	821	3-8

CHARACTER AT d FOR B(I)d BRANCH

d	BRANCH ON	d	BRANCH ON
b1	Unconditional	R	Carriage Busy*
9	Carr. Chan. #9	T	Low Compare B < A*
A	"Last Card" Switch	U	High Compare B > A*
B	Sense Switch B*	Z	Overflow
C	Sense Switch C*	?	Reader Error if I/O Check Stop Switch OFF
D	Sense Switch D*	!	Punch Error if I/O Check Stop Switch OFF
E	Sense Switch E*	≠	Printer Error if I/O Check Stop Switch OFF
F	Sense Switch F*	@	Carr. Chan. #12
G	Sense Switch G*	%	Processing Check with Process Check Switch OFF
K	End of Reel*	/	Unequal Compare B ≠ A
L	Tape Error*		
S	Equal Compare B = A*		
P	Printer Busy*		

CHARACTER AT d FOR MAGNETIC TAPE DISK STORAGE

d	OPERATION	d	BRANCH ON
B	Backspace Tape Record	N	Access Inoperable
E	Skip and Blank Tape	V	Read/Write Parity Check or Read Back Check Error
M	Write Tape Mark	W	Wrong-Length Record
R	Rewind Tape	X	Unequal Address Compare
U	Rewind Tape and Unload	Y	Any Disk Storage Error Condition

CHARACTER AT d FOR 1407 CONSOLE INQUIRY STATION

Q	Inquiry Request	*	Inquiry Clear
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INSTRUCTION	FUNCTION	MNEMONIC	BCD CODE	CARD CODE
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MAGNETIC TAPE %UX TAPE UNIT ADDRESS

L(%UX)(B)d	Read/Write Tape with Word Marks	LCA	d-modifier, R-Read Tape	
M(%UX)(B)d	Read/Write Tape	MCW	W-Write Tape	
M(%CX)(B)R	Read Compressed Tape*	(%CX) is address of tape unit		
P(A)(B)	Move Characters to Record or Group Mark*	MCM	CB421	11-7
U(%UX)d	Control Unit	CU	CA4	0-4
X(A)(B)	Move and Insert Zeros*	MIZ	CA421	0-7

INSTRUCTION	FUNCTION	REMARKS
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COLUMN BINARY

1C	Read Column Binary	C is Modifier
4C	Punch Column Binary	C is Modifier
M(A)(B)A	Move and Binary Decode	A is Modifier
M(A)(B)B	Move Binary Code	B is Modifier
M(%BX)(A)R	Read Binary Tape	%BX is Address of tape unit
M(%BX)(A)W	Write Binary Tape	
W(I)(B)d	Branch if Bit Equal	BBE is mnemonic

DISK STORAGE %FX DISK OPERATION

M(%F0)(B)R	Seek Disk	B is Disk Address
M(%FX)(B)R	Read Disk	X can be 1, 2, or 3
M(%FX)(B)W	Write Disk	1 Specifies Single Record
L(%FX)(B)R	Read Disk with Word Marks	2 Specifies Full Track
L(%FX)(B)W	Write Disk with Word Marks	3 Specifies a Write Disk Check operation M(%F3)(B)W

1407 INQUIRY %TO ADDRESS

M(%T0)(B)R	Read Console Printer	Data from 1407 transferred to B-address
M(%T0)(B)W	Write Console Printer	Data at B-address transferred to 1407
L(%T0)(B)R	Read Console Printer with Word Marks	Data from 1407 transferred to B-address with Word Marks
L(%T0)(B)W	Write Console Printer with Word Marks	Data at B-address transferred to 1407 with Word Marks
M(%T0)(B)W	Line Space	B is address of a Group Mark with a Word Mark